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MILD CURING, PICKLING, DRY SALTING, AND SMOKING SALMON

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Mild-cured salmon is a lightly salted product which is largely dependent on refrigeration for preservation. This method of curing was first introduced on the Pacific coast in 1889 when a shipment was prepared for the German market but the experiment was unsuccessful. Salmon was not mild-cured in large quantities until 1898, when two small plants were established on the Columbia River. Packing of mild-cured salmon began on Puget Sound in 1901. While a few tierces were occasionally packed in Alaska prior to 1906, it was not until then that mild-curing was established on a commercial basis. A large part of the king salmon taken in southeastern Alaska is now mild-cured.

This product must be regarded as an intermediate or half-finished one, since a large proportion of the cure is used in preparing smoked salmon. Some of the pack was formerly sent to Germany and to Scandinavian countries for this purpose. Two world wars have disrupted foreign trade but, meanwhile, markets in New York, Philadelphia, Chicago, Milwaukee, and other large cities, have absorbed a considerable amount of the pack.

General Instructions

Mild-cured salmon must be handled more carefully than any other salmon product. In few food products is handling so important in determining the quality of the manufactured product. Red-fleshed king salmon is used almost exclusively and dressed fish weighing 18 to 20 lbs. are the smallest sizes suitable for mild-curing. There is some variation in this minimum, as at

Astoria, Oregon, fish of less than 30 lbs. in weight are rejected by mild-curers, while in Vancouver, Canada, the minimum size is 18 lbs., dressed weight. From time to time, packs of mild-cured chum and pink salmon have been put up, but have not found a market. Coho or silver salmon is the only other species utilized to any extent for the manufacture of mild-cured salmon and is usually prepared to fill market demands for low-priced smoked salmon. In 1943, according to the Pacific Fisherman, 611 tierces of silver salmon were packed in North America. Tierces average 825 pounds net weight.

Salmon intended for mild-curing must meet certain requirements as to quality: Fish must be (1) strictly fresh, (2) reasonably fat and in good condition; thin fish are not wanted; (3) the skin must be bright -- there must be no "water marks" or other blemishes, (4) the flesh must not be bruised or broken--there must be no pew marks or other signs of rough handling, (5) they must not be belly-burnt, that is, show signs of softening in the abdominal region.

For this reason troll-caught salmon intended for mild-curing are always gutted when caught and packed in crushed ice aboard ship. Salmon taken by other gear are often gutted, or at least packed three or four together in a box filled with crushed ice, which not only acts as a refrigerant, but also aids in drawing out the blood. The boxes may be piled up in several tiers in the hold of the boat, but the weight is distributed, and individual fish are not weighted down more heavily than by the remaining contents of the box.

Butchering

The first step in preparing mild-cured salmon is known as butchering. The butcher first removes the head, cutting from the back and leaving as much as possible of the bony structure just above and below the gills. With this preparation the fish stands up better under handling. If the bony structure were cut away, the sides would break easily in curing, and the hooks on which the fish are hung during smoking would be more likely to tear out.

The fish is then scored with three or four cuts along the lateral line. These are made just through the skin, but should not penetrate into the red meat. Scoring allows the salt to penetrate more rapidly, insuring a better cure. A specially designed, star-pointed wheel is sometimes used for this purpose. It makes a series of small cuts varying from half an inch in length at the tail to one and one-half inches at the shoulder. A number of extra cuts or scores are made if the salmon is large. After scoring, if the fish is not already gutted it is split down the belly to the vent. The viscera or entrails are removed as are most of the belly membranes, and a cut is made along either side of the kidney, the dark red mass found just below the backbone at the top of the belly cavity.

After dressing, the salmon is ready for the splitter, who holds the most important position in any mild-cured establishment. The grading of mild-cured salmon depends largely on the skill of the splitter. An unskilled or careless workman is often responsible for considerable losses. A specially shaped knife is sometimes used in splitting, the end of the blade being nearly square, but the type of knife used depends on the preference of the splitter and varies with individuals. The splitter turns the fish on its side, nape to his right and with the open belly toward him, and then forces the shoulder down on a sharp-pointed nail protruding from the table so that the fish will not slip.

Short incisions are then made under the anal fin and just above and below the backbone. Then, with the upper lug or shoulder tip of the fish in his left hand, the splitter enters his knife at the shoulder above the backbone, and holding the blade steady with the edge at a slight downward angle touching the bone, takes the whole side off with one sweep of the knife. If the work has been well done, little flesh will be left on the backbone and the side will be smooth. A thin line of bone will show down the center of the side which increases the value of the finished product.

To cut the second half loose from the backbone, a cut is made at the shoulder just under the bone. With the edge of his knife resting against the bone at a slight upward angle, the splitter separates the backbone from the flesh down to the root of the tail without removing the fish from the nail, again with one sweep of the knife. As with the first half, little flesh should be left adhering to the bone, and a film of bone should show down the center. In other words, the two sides should be exactly alike.

Washing

The sides are washed thoroughly in cold water and then passed to the sliming table where they are laid skin side down with the thin or belly edge toward the front. All blood clots, loose membranes, and fragments of bone are removed. Any blood remaining in the veins along the abdominal cavity is scraped off by pressing it toward the back of the fish either with the fingers, or the back of a knife blade. If the blood is not squeezed out in this way, the salt will harden it during the process of curing, causing discoloration of the flesh, and lowering the value. Any slight necessary trimming may also be done at this time. Great care must be taken in handling the newly split sides, as they are very tender and may be easily broken or bruished. In lifting them by the lug or collar bone, the curer should have his fingers to the inside and his thumb to the outer or skin side, otherwise the flesh may be broken.

From the slimers the sides are taken to a tank of ice water or iced brine. Warm water tends to loosen up the muscle flakes and if the salmon is left too long in cold water the effect is the same. This tank is known as the "chilling," or more commonly, the "sliming" tank. The latter name is a misnomer as all slime should be removed before the sides go into this tank. The object of this step is to prepare the sides for curing and it may be likened to case hardening. Unchilled sides would absorb too much brine, and the penetration of brine would be too rapid during the first portion of the cure. But this is not the only reason for chilling. It has two other important purposes. Chilling serves to draw out the blood, thus improving the color and also helps to prevent oil from oozing out of the flesh, which is apt to occur where such an amount of cut surface is exposed, especially under pressure during curing. There is some variation in the time the sides are left in the sliming tank. In some localities, the period is for two hours, in others from one-half hour to one hour. The temperature of the brine will vary from 30° to 40° F., and its salinity from 60 to 70 percent. It should be made with fresh water, boiled and strained before use, and changed daily.

After sliming, the sides are drained. This is done in another tank, or the salmon may be placed on a two-wheeled cart or portable table to drain. The fish are transported more easily and it is claimed the water drains off better where the second method is used. On the Columbia River, a cart holds just a tierceful of sides--seven lengthwise of the cart, and three at the end, or ten sides to a layer. This arrangement helps in counting the number of sides going into a tierce.

Salting and Packing

When the sides of salmon have been drained sufficiently, they are taken to the salter, who works from a special bin or box of convenient height, filled with fine salt of the "dairy" type. A special grade of salt known as "mild-cure" is usually required. It fulfills the requirements of low content of chemicals other than sodium chloride, contains no organic impurities and is of small, even grain. The salmon is taken one piece at a time and placed in the salt box, skin side down. Salt is scooped over the side with the hands but it must not be rubbed or pressed into the flesh of the fish as sufficient salt always adheres. The side is picked up by the tips and excess salt is allowed to fall back into the box. It is then packed in a container known as a "tierce."

A tierce is a large barrel, made from fir or spruce, and bound by six galvanized iron hoops. It holds between 800 and 900 pounds of fish with the average around 825 pounds, cured weight. The gross weight, including pickle, runs between 1,100 and 1,200 pounds. A few handfuls of salt are thrown on the bottom of the tierce, then a layer of salmon sides, skin side down. In packing two sides of fish, alternating head and tail, are laid close to opposite sides of the tierce, the back or thick part of each side being placed close up against the side of the tierce. Other sides of salmon are packed from the sides of the tierce toward the center, napes and tails alternately, the back of each side being drawn half way up and resting on the side already laid. When complete, the layer should be level, this depending a good deal on how the last or center piece is laid. A little salt is scattered over each layer before starting the next one, and each layer should be laid at right angles to the one preceding. The top layer should be packed skin side up, and a little more salt should be scattered on this layer than on the others. The amount of salt used varies from 85 to 120 pounds to the tierce. One of the leading Canadian mild-curers uses 90 pounds of salt to the tierce, and this may be taken as the average, but some curers use as much as 15 pounds of salt per hundred pounds of fish.

There is some variation in the curing process at this stage. The tierce is filled only to the croze and in some districts it is headed up at once and filled with a 90° to 95° brine until the tierce will hold no more. In others the tierce is left from 24 to 48 hours before heading, and is then headed and filled with 100° brine. The pickle or brine should be made from the same salt used for rousing and packing the fish. The water used in making the brine should be clear and pure--in fact, drinking water. Before using, the pickle should be strained through a fine sieve or piece of clean cheesecloth to free it from any froth, dirt, or sediment. The strength of the brine is then determined by a salinometer. A centigrade scale salinometer is used by most mild-curers. The brine is usually made up to a strength of 90° C., but during the first week or ten days of the cure while moisture is being extracted it sinks to 70° C. in strength. After repacking, the strength of the brine should not fall below 85° C., and it should hold this strength some time.

After the tierces have been headed and filled with pickle, they are usually rolled into a room where the temperature can be kept down to from 32° to 34° F. Here they are stored in rows one or two tierces in height and left to cure. The temperature of the storage room should not be allowed to fluctuate, as this causes the oil to exude from the flesh, and to escape into the brine. The tierces are not always rolled into the chill room immediately after packing.

Some curers, especially those working in cooler climates, leave the tierces out in the packing room for four days, then send them to the chill room for 10 to 20 days before repacking.

If the tierces are not kept full of pickle the sides of fish are apt to get shaken about and broken when the tierces are shifted while being inspected at intervals to determine the presence of leaks. No tierce is perfectly tight at first, and the staves absorb some brine. If any part of the fish is left uncovered by the brine, yellow, discolored spots develop, so-called rust spots, which lower the quality of the finished product. Therefore, it is extremely important to see that the tierces are kept full of brine during the curing period and also after repacking. A tierce of salmon may absorb several gallons of pickle in the first two or three weeks of cure, especially if the fish are "dry."

The amount of shrinkage during the first three weeks before repacking may be estimated at about 30 percent. Less shrinkage occurs in fat, ocean-caught fish, but thin, "dry" fish, especially those caught when well on their way to the spawning ground, may shrink as much as 35 percent in weight.

After the salmon has been held in storage at least twenty, but not more than ninety days, it is repacked. The tierces are rolled out and unheaded. Each piece is taken out carefully, remembering to hold the sides with the fingers on the flesh side and the thumb on the outer, or skin side. The sides are sponged or cleaned off, removing all salt or other material on the surface. Either ice water or chilled brine are used to wash the sides of salmon, depending on condition. If the fish are soft and rather poor, they should be washed in brine, but if the sides are firm and thick, ice water may be used. It is the opinion of some curers that chilled brine should always be used.

Weighing and Grading

The next step is weighing and grading the sides. Unlike curers in other districts, those on the Columbia River grade twice. While the fish are being dressed three chilling tanks are used, one for each size. A rough grading into large, medium, and small sides is thus obtained. This is an advantage in packing and curing as the time required for curing varies with the size of the side and much work is also saved in sorting for repacking. When repacking, a careful separation is made into from 6 to 10 grades. The designations of the grades depend on the number of sides needed to fill a tierce, and are expressed as 40 to 50, 50 to 60, 60 to 80, 80 to 100, and 100 to 120 (sides per tierce). Slightly broken sides are graded as "B" of that size, other more defective sides are placed in a third grade and called culls. Color of the sides is also considered in grading, and pale or off-color sides are segregated. The system of grading differs somewhat in various districts, but the description given indicates the general method.

In repacking, the sides of fish should be replaced as nearly as possible in their original position; those curved in shape being placed against the sides of the container, and straight pieces laid in the center of the layer. No salt is used in repacking, but as soon as the tierce is filled, the head put in, and an examination made to determine the tightness of the tierce, it is laid on the side opposite the bung, and filled with ice cold pickle made to a strength of 90 to 95° salinometer. The tierce will contain about 825 pounds of salmon after repacking, and some 14 gallons of brine may be required to fill it. The gross weight will average 1,100 pounds. The tierce is then put back into chill storage

and filled up daily with pickle, through the bunghole, for a week or more. If mild-cured salmon is stored for any length of time, the tierces must be tested for leakage at frequent intervals.

The head of each tierce is marked to show: number of the tierce (consecutively); the number of sides of salmon in the tierce; and the net weight and the initial or brand of the packer. In some districts the tierce is marked with the packer's initials, place where packed, number of tierce, number of sides of salmon in tierce, the tare, gross, and net weight, quality of fish (I, II, and III or T), and size of fish L (large), M, (medium), or S (small). In Vancouver, Canada, thin or broken sides are designed by the letter X. If the salmon is of first quality no special mark is necessary, but second and third quality fish are always designated.

Storing

Mild-cure salmon must be shipped under refrigeration and held at all times in cold storage. It is kept at a temperature of 32 to 34° F., after repacking, but some packers, if the salmon is to be held for more than three months, hold it at a temperature of 28° F. The salt cure is not of sufficient strength to delay spoilage for more than a brief period. At one time attempts were made to reduce or eliminate refrigeration in connection with the mild-curing of salmon, by adding various preservatives. These were usually preparations of salicylic or boric acid, and the benzoates or other chemical compounds now limited in use by food and drug administrations, here and abroad. The use of these agents was soon abandoned, however, as it was found that quality was affected and the product was becoming unfavorably regarded by the buyers of cured salmon, so artificial preservatives have not been used since the earliest days of the mild-cured salmon industry.

PICKLED OR HARD-SALTED SALMON

Pickling or brine salting was the first method of preservation followed in the commercial utilization of the Pacific salmons. Long before any permanent settlement was made, our ships visited the northern Pacific coast to put up cargoes of salted salmon, which were later traded in Hawaii for sandalwood, or in China for furs, silks, teas, spices, or other Oriental goods. Hawaii remains today one of the principal markets for hard-salt salmon.

The method is found on a commercial scale in Western Alaska. While pickled salmon has been prepared at other points along the coast, no commercial packs have been made elsewhere for some years.

All five species of salmon are used to some extent in the preparation of hard-salt salmon, but the red salmon is the principal species used and is regarded as yielding the highest grade product. A considerable amount of pink salmon and silver or coho salmon is also salted. While king and chum salmon are occasionally used to some extent, very little of these two species is hard-salted. Some pickled salmon bellies are still put up, but the pack is very small. This is a choice product, but under the present law, bellies may only be packed when the rest of the fish is used for food in some other way. The major portion of the belly pack is made from pink salmon.

Quality is an essential consideration in packing salt salmon. It is important to use only fresh fish, for if not of this quality, soft bellies are very evident after salting. If the fish are stale, the bones will come loose from the flesh and stand out, giving the fish a ragged appearance. Salmon approaching the spawning stage cannot be used because of discoloration of the skin. The use of pews in forking the fish about is also detrimental in curing a good grade of pickled salmon. The holes made by the prong cause spoilage to advance more rapidly and dark streaks are left in the flesh, detracting from its appearance.

Butchering

When the salmon are brought in to the saltery, they are washed, slimed, and beheaded, after which they pass to the splitter. There are two methods of splitting. In the first, the fish is split along the back, ending with a curving cut near the tail. The abdominal side is left as a solid section. Some two-thirds of the backbone is then taken out, and all viscera, blood, and membranes are scraped away. In the second method the fish is split along the ventral side, eviscerated, and all membranes are scraped from the abdominal cavity. In splitting, the neck end of the salmon is toward the splitter, who makes a slight incision at the neck end, just above the backbone. The whole side is then removed with one sweep of the splitting knife, leaving as little flesh along the backbone as possible. The knife is usually held so that the edge of the blade is at a downward angle. A short cut is made under the backbone on each side, just about the region of the anal opening. Another slight cut under the neck end of the backbone, and one sweep of the knife removes the entire backbone and tail. The two cuts are made under the backbone to direct the course of the knife, preventing it from slanting too much in splitting. Slanting causes considerable flesh to be left on the backbone, which is of course wasted. Some curers make one or more longitudinal slashes in the flesh so that the salt will "strike" or penetrate more rapidly. The loss in weight in cleaning and splitting averages 25 percent.

Washing

After splitting, the salmon passes to the cleaners. These men scrape out blood clots and the kidneys, and remove membrances, loose bones or other offal. After cleaning, the fish is scrubbed thoroughly inside and out. Care must be taken not to injure the flesh, however. A final cleaning is given in the washing tank and the salmon are then drained thoroughly, preparatory to salting.

Salting

Both round and square salting tanks are used, but the capacity of a tank should be not more than one hundred barrels. If the tank is too large, pressure on the lower layers of fish is excessive, and as a result sides of fish in these layers are distorted or otherwise injured. A thin layer of salt is scattered over the bottom. A layer of fish is then laid in with the flesh side up. No special system is followed in packing, and the only rule is that the work must be done neatly, with the layers as level as possible. Each layer is covered with salt, using from twenty-five to thirty pounds of salt to a hundred pounds of fish. Care must be taken that each fish is completely covered. The tanks are filled several layers above the top, to allow for shrinkage and the top layer is laid with the skin side up. The tank should be covered at all times, however, to prevent "rusting," that is, discoloration caused by oxidation. The fish are allowed to make their own pickle, which is formed as the salt extracts moisture from the

flesh, bringing the salt into solution. From ten to fourteen days will be required for this curing process, though the salmon may be left in the tank for a longer period of time. Curers do not agree on the loss of weight in salting. The best estimate at present is that about fifteen percent of the moisture content is removed.

Grading and Packing

The next step is repacking into barrels containing 200 lbs. net weight, exclusive of brine. In repacking, the fish is washed in brine and scrubbed well, usually with a stiff brush, though pieces of burlap have been used for this purpose. All slime, blood clots, excess salt, or other waste material should be removed. The salmon is then graded: (1) as to species (if one species only is being cured, this is not necessary); (2) the color of the flesh and skin, according as the flesh is of good color and the skin bright, or the flesh pale in color, with the skin murky or discolored; (3) as to quality--good or poor, that is, fish which were not strictly fresh when packed, and have a characteristic odor and flavor, must be separated from the rest of the pack.

After sorting, 200-lbs. net weight of fish is weighed out for each barrel to be packed. The sides are packed in, flesh side up, except for the top layer. A liberal sprinkling of salt is scattered at each end, but only a little is thrown between the layers. From 8 to 10 lbs. of salt should be a sufficient amount for repacking a barrel of salmon, if the fish have been properly cured. After the barrels have been headed they are filled with 100° (salinometer) brine, through the bunghole. On one end of each barrel is stenciled the packer's name or brand, the species of salmon, and grade.

SALTING SALMON BELLIES

A few salteries also pack bellies which are merely the ventral sections, the fattest and choicest portions of the fish. So much salmon was formerly wasted by this method, that the preparation of this article was forbidden under the Alaska fishery regulations unless some economic use is made of the remaining portions of the fish. (Section 8, Act of June 26, 1906, 34 Stat. 480; 48 U. S. Code 236.)1/

In preparing salmon bellies, the curer first cuts off the two pectoral fins and then removes the head, taking care to follow the curve of the body until the backbone, which should be cut straight across, is reached. With smaller salmon, the fish is then turned on its back, a knife is inserted vertically in the body just above the backbone, and a vertical cut is made through the body, the knife coming out just in front of the anal opening. If properly done, the cut will come close to the upper wall of the abdominal cavity. With large king (also known as spring or chinook) salmon it is sometimes necessary first to make a cut on one side, then turn the fish over and cut through on the other side. The belly is then laid flat on the cutting table and the membrane at one end cut so that the belly will lie flat.

The bellies are washed thoroughly in clear, cold water, or in iced brine. The remainder of the process is identical with that just described for hard-salted salmon. Bellies are sent to the Seattle market in barrels holding 200 lbs. net weight of fish, but are usually repacked for distribution to the retailer in small kits or tubs of various sizes.

1/ Also included under Section 201.17 of the Laws and Regulations for the protection of the commercial fisheries of Alaska. Fish and Wildlife Service, Department of the Interior, Washington, D. C.

DRY SALTING SALMON

Large quantities of salmon are dry-salted every year on the Pacific coast, mostly for export to the Orient. The greater portion of the pack is prepared in British Columbia. Little interest in this method of curing salmon has been shown in the United States for a number of years, but occasionally, when chum salmon are in little demand for canning purposes, quantities are available for dry salting at a price which should show a profit on the finished product.

Chum (dog) salmon is largely used in the preparation of dry-salted salmon though other species are sometimes used. In Siberia, where an increasing quantity of dry-salted salmon is put up every year, red and coho salmons are used to some extent.

In preparing dry-salt salmon, the heads are cut off, the fish split down the belly and eviscerated. The blood is scraped out as thoroughly as possible and the fish split again, if large. The backbone may or may not be removed, depending on the custom of the individual curer. As a rule, it is removed when the salmon is split. Small fish may be split almost through to the skin, but are left in one piece, and the backbone is not removed. The dressing and splitting process is the same as that already described in the method for hard-salted or pickled salmon, but is done with less care.

When the salmon are cleaned and split, they are laid down in stacks, with a heavy layer of salt between each layer of fish. All layers are piled flesh side up, with the exception of the top layer, which is laid skin side up, for the purpose of better protecting the fish against dirt or other contamination. If packed in large salting tubs or vats, the salmon sides are arranged as neatly as possible alternating heads and tails with the thick edge toward the side of the tub, small pieces being packed in the center to make the layer even. If cured in stacks or kenches, the salmon are laid down in rows, alternating heads and tails. The amount of salt required in dry salting is approximately 35 lbs. of salt per 100 lb. of fish.

When the fish appear thoroughly cured, they are packed in boxes holding 400 to 500 lbs. of fish, with salt scattered between the layers. No particular system is followed in packing, except that the packers endeavor to make even layers without large air spaces. From 5 to 10 lbs. of salt per 100 lbs. of fish will be used in repacking. The product receives no further processing, but if it is to be held any length of time before shipping, it should be repacked.

SMOKED SALMON

Several different methods of smoking salmon are used. Formerly a large proportion of the pickled or hard-salted red salmon from Alaska was shipped to Europe and the eastern part of the United States for smoking. Today, mild-cured chinook or king salmon is most used in salmon smoking, but varying quantities of silver, or coho salmon, are cured for this purpose, espacially for the low-priced markets. Fresh salmon, lightly salted, is occasionally used for smoking, but the quantity so employed does not compare with the amount of mild-cured salmon used for the same purpose, with the exception of kippered salmon, for which fresh or frozen salmon is invariably used.

In preparing smoked salmon from mild-cured fish, the sides of salmon are taken out of the tierce and soaked over night in a tank of fresh water, changing

the water two or three times. Ten or twelve hours freshening should be sufficient, but a more thorough soaking may be required by some markets. Certain smokers freshen salmon for ten hours in a tank with running water, especially if a large quantity is to be smoked. When properly freshened, the salmon is washed with a stiff bristle brush, to remove all traces of blood, slime, or encrusted salt.

The next step is draining and trimming. Draining is often done by water-horsing--that is, the salmon is placed in a pile, flesh side down and a weight placed on top of the pile to press out the water. After enough moisture has been drained from the flesh, the sides are trimmed of any ragged edges and wheeled on barrows or hand trucks to the smokehouse.

Wire hangers are used for hanging the salmon on sticks in the smoke house. These are made of steel wire or light iron, and have six points at right angles to the frame at the lower end, and a curving hook at the top to hang over the smoke stick. A side of salmon is laid out flat, skin side up. The points of a hanger are pressed through the skin at the nape or neck end. Another workman in the smokehouse hooks the handle over a round smoke stick. In hanging the salmon, care is taken to leave sufficient space between sides and to guard against crowding or overloading the smoke house, which would result in an inferior product with a shorter period of preservation.

The time required for the smoke cure depends primarily on the length of the period of preservation desired. If the product is for immediate consumption, 10 to 12 hours cure over a dense smoke should be sufficient. However, in most cases a longer cure is required as the smoked salmon may not be consumed within the next 24 or 48 hours. So, in these instances, after the smoke house has been filled, a fire is started in the pit below and for some hours the fish is smoked over a clear fire with the ventilators left open so that moisture can escape, preventing the salmon from sweating in this initial period of smoking, which is really more or less of a drying process.

When the first period of the smoke cure has been finished, that is, after about 48 hours, the ventilators in the top of the smokehouse are closed, and the fire smothered with sawdust. A dense smoke is thus created, in which the salmon is cured for an additional period of two to three days. If a still more durable article is desired, that is, on which may be marketed over a wide area, and one which will keep longest under average conditions of temperature, handling, and storage, the curing may require a week to complete. In such case, the fire is kept low and smoldering during the entire period of the cure, not forming dense smoke. The process is a dehydration as much as a smoke cure.

When the cure is completed, the smokehouse doors and ventilators are left open. After the smoked sides are sufficiently cooled, they are weighed, wrapped in oiled or parchment paper, and packed in boxes with a usual net weight of 30 pounds. Smoked salmon must be stored at temperatures of from 33 to 40° F., if it is to be held any length of time, especially in summer.

The length of the smoking period and other factors involved in smoking salmon vary with the locality, type of product demanded by the trade, temperature used in smoking process, humidity, and similar factors. The process must be altered to meet changes in these conditions. Exact data as to temperatures giving best results are lacking. However, this is a cold-smoking process; though the fire

must be high enough to cure the salmon; it must not give off too much heat, or the product will be partially cooked, and soon spoiled. The temperature should not exceed 90° F., and in general should be somewhat lower. As to the best type of fuel, alder wood is most commonly used on the Pacific coast, but almost any non-resinous wood such as maple or beech gives satisfactory results. Oak and hickory are favotite fuels among salmon smokers in the Atlantic coast area.

A small amount of smoked salmon is sliced like bacon or ham, wrapped in cellophane and sold in half or quarter pound packages to the delicatessen and grocery trade. Sliced smoked salmon is also packed in quarter-square cans of the type used for small oil sardines. A little olive or cottonseed oil is added to each can which is then sealed hermetically but not sterilized. While this product is not so perishable as ordinary smoked salmon, it does not have an unlimited period of preservation, and should not be exposed to high temperatures, or other unfavorable storage conditions. The maximum of preservation is achieved by keeping this product in a refrigerator or refrigerated showcase.

BELEKE

Some attempts have been made on the Pacific coast to market a hard smoked and dried salmon known as beleke, or Indian cure. Though it is superior in keeping quality and equal in flavor to salmon smoked by other methods, it has not met with much favor outside of Alaska as it is dull in color and therefore does not have the attractive appearance of the more perishable smoked salmon products. It is prepared commercially in Alaska for distribution in the territory and to a small extent in the Northwestern United States. Beleke makes an excellent appetizer or relish to be served with beverages, and there are possibilities in developing a better market. Red and coho salmon are the species used in preparing this product. One authority states that the backs only are used, cut in two or three long strips, the bellies being pickled and sold salted. Packers of beleke have informed the writer that though this may be done, it is quite as usual to smoke whole sides of salmon by this method.

If the bellies are to be utilized, pickled or hard-salted, the remaining edible portion of salmon is split in two sides, the backbone is removed, and each side is cut into several strips, longitudinally. These may or may not be washed in salt water. The largest, thickest strips of back flesh are then placed in a tank of 90° (salinometer) brine, followed in an hour by strips of medium size, and after an interval of another hour by smaller pieces. This procedure is followed so that all sizes will have the same degree of pickle. The strips are removed and drained after a period of from 16 to 20 hours. If whole sides are to be used, after cleaning and dressing as described under the preparation of pickled salmon, the fish is brined overnight or for a period of 10 to 12 hours in a 90° brine.

After brining, whole sides are fixed on smoke sticks, while strips are usually suspended by cords, run through one end as in smoking bacon at home. The fish is given an air drying of 24 hours to remove the surface moisture. At the end of this time the salmon is placed in the smokehouse, the ventilators are left open, and the salmon is smoke-cured over a fire of green alder wood. The smoking is done very slowly at a low temperature, not more than 70° to 80° F. Two weeks is the average period of time required to smoke beleke. This product was first prepared around Kodiak, Alaska, but a similar process is used in smoking salmon in other sections of Alaska. Beleke is said to have better lasting qualities than any other smoked fish, remaining in good condition for two and even three years. If surface mold begins to appear in storage, the fish is taken out, scrubbed in brine, given an air drying of several hours and is then smoked for from 24 to 48 hours after which it is restored to a cool, dry place.

KIPPERED SALMON

Kippered salmon probably has a larger sale than any other smoked fishery product on the Pacific coast. It is sold in a few large centers in the east and middle west, but the greater part of the production is consumed in the western part of the United States. Practically all kippered salmon is prepared from white fleshed chinook (king) salmon. This fish has little sale in the fresh fish market where it is considered inferior to other salmon by reason of its paler color. However, it is equal to the brighter colored salmon in food value and often has a better flavor. A constant supply of fresh fish at prices making profitable operation possible cannot be assured throughout the year, while frozen salmon is available all the year round, giving the curer an assured supply of raw material without wide fluctuations in price. Therefore, frozen salmon is used during a great part of the year and is split before it is completely thawed. Fresh salmon is much softer in texture, requires more care and skill in splitting, and the smoking period must be somewhat longer.

The first step in the curing process is to thaw out the salmon in tanks of cold water. In some establishments thawing is done with running water, in others, with standing water, changed several times. The time required for thawing varies from 8 to 15 hours depending on the size of the salmon, and whether or not running water is used. Smaller-sized fish placed in running water will be sufficiently thawed in 8 hours. As the salmon has already been cleaned and dressed before freezing, it is split into sides when sufficiently thawed, the backbone is removed, and the sides are cut into a number of smaller pieces. These pieces usually weigh about one pound each after curing, and are separated according to thickness. The thinner pieces will cure more rapidly, which is one reason for separating them, while another is that the thickest pieces are considered best grade. There are three grades or sizes (chunks), the thickest part of the back flesh; thins, pieces of flesh not quite so thick; and strips, thin pieces from the bellies of the fish. The names used for the grades may vary with the locality and among different curers but the separation into three grades is followed by practically all establishments on the Pacific coast. The third grade or size--for there is little difference in the quality--usually goes to the lower price markets. The Jewish trade buys a considerable amount of the strips as this size has a much higher oil content than the other two, the richer flesh meeting favor among the Jewish population.

After cutting, the salmon is placed in a 90 to 95° salinometer brine for from thirty minutes to two hours and thirty minutes, the length of the brining period depending on the size and thickness of the pieces, local preference in the market for which the salmon is destined, and on the time required for shipment.

When sufficiently brined, the salmon is drained, then dipped into a tank or tub of coloring matter. The dye may be added to the brine, combining the two operations in one, in which case the amount of dye used is less than when the fish is colored by dipping. The dye most often employed is 150 Orange I, an aniline dye, the use of which is permitted under the Federal Food, Drug and Cosmetic Act. Other red or orange dyes on the permitted list may be used. The dye solution is made up in strengths dictated by the experience of the individual curer, and it is not possible to set down exact rules as to the mixing of the solution which will apply to every situation. Where the fish is dipped in the dye after brining, experiments, carried out at the College of Fisheries, University of Washington,

indicate that dipping for 15 to 30 seconds in a solution made up in the proportion of one part of dye to three thousand parts of water is sufficient. This is given only as a general formula, to guide those without practical experience. The curer must determine requirements by experiment, and according to the desires of his customers as to the shade of color. The fish is dyed owing to a popular prejudice against a lightly colored kippered salmon. The dye used is harmless and does not affect the quality of the fish in any way, while it gives it an attractive color. For certain markets, principally in States where all artificial food coloring is prohibited by law, no dye is used.

When the salmon has drained for a short time, it is put into wire mesh-bottomed trays, made of half-inch mesh with wooden frames. These trays should be thoroughly cleaned before use and the wire mesh rubbed with lard oil or some other edible oil to prevent pieces of fish from sticking to it. The pieces in a given tray are, as nearly as possible, of the same size and thickness. They must not touch each other, or an even, sufficient cure will not be obtained. The individual trays may be alid onto a rack holding several tiers of trays and moving on wheels, which is run into the smokehouse when it has been filled; or the trays may be placed directly in the smokehouse on fixed racks.

The salmon is allowed to drip and drain for a few hours in the smokehouse; but a suggested procedure, which it is believed would shorten this period and result in a better product, is to dry the trays of fish for an hour or two under a strong current of air at a temperature of about 70° F. The fire is now lighted and the salmon is smoked lightly and partially dried over a medium fire (temperature in the section holding the fish should be about 80° F.) for from 7 to 12 or 13 hours. At the end of this time the fire is built up and the salmon is given a hot smoke by which it is partially cooked. Care must be taken that the salmon does not get overheated, or it will be softened and spoiled. When the fire is built up it must be regulated by means of drafts and ventilators so that the temperature will not be higher than desired. This hot smoking or barbecuing takes one hour at a temperature of from 170° to 180° F. In some establishments the time is 25 to 35 minutes at a temperature around 250° F.

When the process is finished the kippered salmon is thoroughly cooled, in some cases, by throwing open the doors of the smokehouses. In others, in plants which are equipped with movable smokehouse racks, the racks are run out on the floor and the fish cooled under a current of air. The pieces are given individual wrappings of parchment and are then packed in a small box or basket. A container holding 10 pounds is the most popular size. Kippered salmon is perishable, spoiling after exposure of a few days at ordinary temperatures, so if not to be sold at once it should be kept in chill storage at temperatures of 35° to 40° F., and sold from refrigerated show cases. A certain amount of kippered salmon is intended for shipment to distant markets, or is stored to fill rush orders. For these purposes it is frozen and held in storage for use as required. The freezing temperature and length of time required for freezing are the same as for fresh fish. As in freezing fresh fish there is some variation, but in a typical instance kippered salmon is placed in the sharp freezer at-10° F., and left there for 10 to 12 hours when the temperature should be-25° F. The storage temperature is about 0° F.